Near-infrared Spectroscopy Resaturation Indices Can Differentiate High and Low Muscle Quality: A Pilot Study

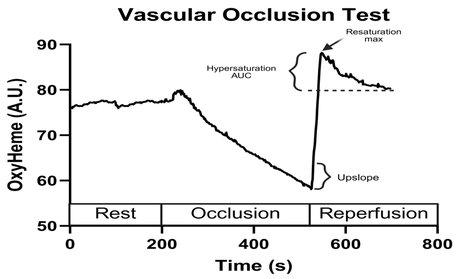
Kase J. Pennartz[1], Jiwon Song[1], Joshua L. Keller[1]
[1] University of North Texas; Denton, TX

iLEAP
INTEGRATIVE LABORATORY OF EXERCISE & APPLIED PHYSIOLOGY

NSCA® NATIONAL STRENGTH AND CONDITIONING ASSOCIATION

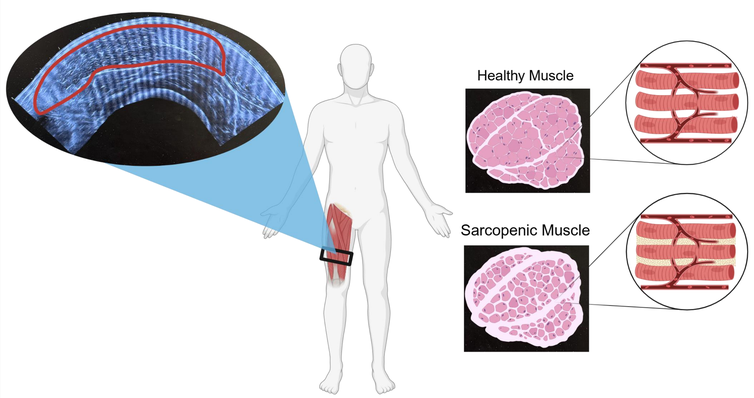
Background

- Near-infrared spectroscopy (NIRS) in combination with a vascular occlusion test (VOT) is a non-invasive assessment to characterize microvascular function and health in skeletal muscle



- Echo intensity, determined via ultrasonography, is used to characterize skeletal muscle quality (MQ) by the echogenicity of contractile and noncontractile components such as intramuscular adipose infiltration.

- Higher amounts of adipose tissue increases capillary diffusion distances, limits blood flow, and reduces oxygen delivery to working muscles.

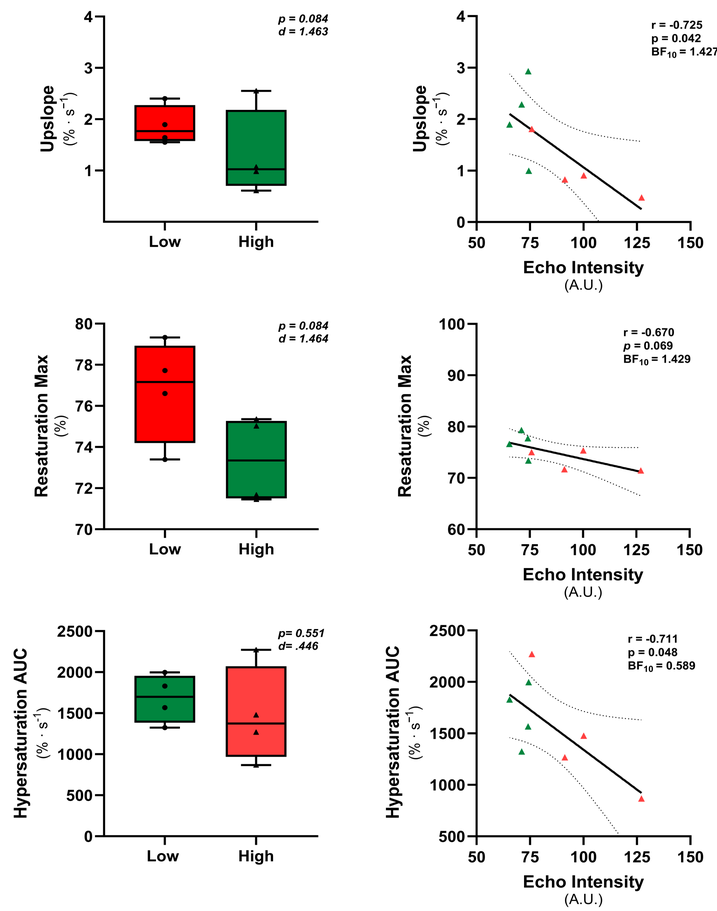


- Thus, this relationship may serve as a marker of muscle impairment and disease. However, few studies have examined the sensitivity of NIRS in distinguishing between different levels of muscle qualities.

Purpose

➢ The purpose of this investigation was to examine whether differences in NIRS re-saturation metrics could differentiate individuals with high or low muscle quality.

Results



Methods

- Participants completed
  - → Body composition analysis
  - → Ultrasonography
  - → NIRS + VOT
- Muscle quality was assessed using ultrasonography-derived echo intensity, which was corrected for adipose tissue thickness.
- Oxy[heme] resaturation metrics were calculated from the recovery period following a VOT including:
  - → upslope
  - → resaturation max
  - → hypersaturation area under the curve (AUC)
- Participants were dichotomized into two groups at the median.
- Statistical analyses included:
  - → 3 independent t-tests to assess
  - → bivariate analyses were performed between re-saturation metrics and corrected echo intensity
  - → Statistically significant was set at $p \leq 0.05$

Conclusion

- Individuals with better MQ tended to exhibit faster upslopes and higher re-saturation max values than those with poorer MQ. Thus, NIRS re-saturation indices might be able to differentiate individuals based on their muscle quality. This may be further supported with additional participants. Our future studies will continue to examine the utility and sensitivity of NIRS assessments.

Practical Applications

- Strength coaches remain uniquely qualified to develop skeletal muscle for athletic, clinical, and recreational populations. Based on our findings, improved MQ coincides with improved muscle oxygenation in response to various stresses like transient ischemia. Overall, an individual with adequately developed skeletal muscle will likely exhibit superior oxygen-based recovery characteristics and more resilience to strenuous exercise bouts.

UNT | COLLEGE OF EDUCATION
Department of Kinesiology, Health Promotion & Recreation

References:
Cadore EL et al (2012) Echo intensity is associated with skeletal muscle power and cardiovascular performance in elderly men. Exp Gerontol 47:473–478. https://doi.org/10.1016/j.exger.2012.04.002
Tyml, K., & Mathieu-Costello, O. (2001). Structural and functional changes in the microvasculature of disused skeletal muscle. *Front Biosci*, *6*(D45-D52), 10-2741.
Stock, M. S., & Thompson, B. J. (2021). Echo intensity as an indicator of skeletal muscle quality: applications, methodology, and future directions. *European journal of applied physiology*, *121*, 369-380.